stated that $\frac{1}{1000}$ part of antimony will convert the best select copper into the worst conceivable. Another instance occurs in the case of iron. By the addition of $\frac{2}{10}$ per cent of carbon steel is produced of such a kind as would make an excellent bridge, or boiler plate, but if fashioned into a weapon would be absolutely untrustworthy. If, on the other hand, $\frac{8}{10}$ per cent of carbon were introduced, a material is obtained from which a good razor might be made, but it would be useless for a rail or the construction of a bridge. A trace of manganese in steel renders it impossible to make a magnet out of such a specimen. It also prevents the hardening of such steel by rapid cooling after heating to redness.

The metal, however, which shows the most remarkable change in its physical properties when contaminated with next-to-nothing of a foreign substance is gold. The addition of $\frac{2}{10}$ per cent of bismuth would render a specimen of gold useless for coinage purposes, as it would crumble to powder under the pressure of the die. Lead acts in a similar way. One part of lead added to two thousand parts of gold reduces its tenacity from 18 tons per square inch to only 5 tons. A bar of such gold can be readily broken by a tap from a hammer. The color of the gold is changed from yellow to orange brown. Such a remarkable change in the appearance and properties of gold on the addition of small quantities of other substances was known in the seventh century and helped to confirm the belief of the alchemists that they had only to find some substance which would alter the properties and appearance of any given metal so that it would change into and acquire the properties of gold. Hence the search for the philosopher's stone.

This paper might be indefinitely extended, but enough has probably been said to show that even in chemistry the day of small things is not to be despised, and that a thorough investigation of some of the commonest and best-known chemical changes would doubtless bring to light many facts at present overlooked, and would tend to a better understanding of the workings of nature.

BREAD-FRUIT TREES IN NORTH AMERICA.

BY F. H. KNOWLTON, U. S. NATIONAL MUSEUM, WASHINGTON, D.C.

THE living species of the genus Artocarpus are exclusively Old World, being confined in their distribution to tropical Asia and the Malay Archipelago. About forty species have been described, of which number two or three are now widely cultivated throughout the tropics, the most important of these being *A. incisa*, the true bread-fruit tree. They are small or medium-sized trees with a milky juice, and large, leathery, entire, or pinnately lobed, or rarely pinnately compound leaves. The flowers are monœcious with the staminate ones borne in long club-shaped spikes, and the pistillate in rounded heads. The female flowers soon grow together and form one large, fleshy mass, or the so-called bread-fruit. When mature, the fruit is marked on the exterior with hexagonal knobs, and in the interior consists of a whitish pulp, having the consistence of new bread, whence its name.

Although not at present an element in the flora of the New World, there is now abundant evidence to show that the genus Artocarpus was, during late Cretaceous and earlier Tertiary times, an inhabitant of North America. The best known species, called *Artocarpus lessigiana* (Lx.), was discovered in 1874 in the Lower Laramie on Coal Creek, in Boulder County, Colorado. It was first described by the late Professor Leo Lesquereux, under the name of *Myrica ? lessigiana*, on the supposition that it was a gigantic representative of the genus Myrica. Specimens, now known to represent the upper portions of large leaves, were later obtained from the andisitic deposits forming the recently differentiated Denver formation of South Table Mountain, near Golden, Colorado. These leaves were called *Aralia pungens* by Professor Lesquereux, who naturally confounded the imperfect examples at his disposal with well-known fossil forms of this genus, which they much resemble. Since that time several additional specimens have been obtained, which not only prove that *Myrica ? lessigiana* and *Aralia pungens* are identical, but also that they should be referred to Artocarpus.

The leaves of *Artocarpus lessigiana* were very large, measuring 30 centimeters in length and 18 or 20 centimeters in width. They are thick, probably coriacious in texture, broadly oblong in general outline, and deeply, pinnately 4–6-lobed. The lobes are oblong, lanceolate, taper-pointed, and separated at the base by broad, rounded sinuses, the lobation being most extensive at the base of the leaf, where the sinus almost reaches the midrib, and the two lower lobes are connected by a narrow ring only. The nervation of the leaf is very strong, and precisely like that of the living *A. incisa*, which differs from the fossil in having the deepest lobation in the upper part of the leaf.

Closely allied to this species, and possibly identical with it, is what I propose to call *Artocarpus californica*, which is founded upon specimens obtained by Dr. Cooper Curtice, then of the U. S. Geological Survey, from the auriferous gravels at Independence Hill, Placer County, California. This species differs from the former by its smaller size, thinner texture, and shorter, more acute, lobes. It is not sufficiently well preserved to show the finer nervation, but, as far as can be made out, it is very similar to *A. lessigiana*, and additional material may show them to be the same.

Specimens, probably belonging to this species (*A. californica*), were obtained some years ago from the John Day Valley in Oregon, the age of which is either Upper Miocene or Lower Pliocene. They were identified by Professor Lesquereux both with his *Myrica ? lessigiana* and *Aralia pungens*; but, as they are somewhat fragmentary, it is not possible to be positive as to their correct determination.

The most northern point at which the genus Artocarpus has been found fossil is northern Greenland, in latitude 70°. Dr. A. S. Nathorst obtained a large leaf, which he named *A. dicksoni*, in the Cenomanian near Waigatt. This species is also closely related to *A. incisa*, and was associated with a fruit which is unquestionably that of a bread-fruit tree. Nathorst, who was the first to point out the true relationship of Lesquereux's *Myrica ? lessigiana* and *Aralia pungens*, suggests the possibility of their being the descendants of the Greenland species, which may have deen dispersed over the North American continent by the ice-sheet. The material at present available is hardly sufficient to establish unquestioned relationship between them, for the nervation of *A. dicksoni* is not to be made out, but, as all are undoubtedly related to the living bread-fruit (*A. incisa*), they may be more closely related among themselves than now seems apparent.

From the above account, it appears that the bread-fruit trees existed in North America as far north (in Oregon) as 46°, and as late as early Pliocene or late Miocene time. The reason for their complete disappearance from the American flora, and that within such a comparatively short space of time, is difficult to supply. If they had been pushed southward, and now inhabited the tropics, it would be readily explainable, and quite in accord with other well-known instances, but they have totally disappeared from the New World, notwithstanding the fact that they grow when transplanted as freely in tropical America as in their native country. It is probable that the advance of the refrigeration was so rapid that they were unable to escape in the New World, and perished to the last one, while in the Old World some avenue permitted their perpetuation. The genus Eucalyptus is another example of the same condition. During Cretaceous and Tertiary times it was an inhabitant of North America and Greenland, but is now entirely confined to Australia.

The deductions to be drawn, as to the climate that prevailed at the time when these trees existed in North America, are to be made with caution. The fact that all the living species of a genus are tropical does not necessarily prove that it has always been so. Again, a genus that is essentially tropical may have species extending into sub-tropical or even temperate regions. The genus Dicksonia is a marked example of this kind. It is principally an inhabitant of tropical America and Polynesia, but one species reaches as far north as Canada, and several are scattered throughout the southern part of the temperate zone.

Taken by itself, Artocarpus would indicate a tropical climate, but the plants with which it is associated have also great weight

in confirming or modifying this view. In Greenland it is associated with ferns of the order Gleichenialeæ and at least four species of Cycas, all of which goes to prove that the climate at the time they grew was probably tropical, or at least very warm. In North America the Laramie bread-fruit tree was associated with an abundance of palms, which also argue a warm climate, but in the same beds are found a host of genera (Salix. Populus, Quercus, Juglans, Carga, Magnolia, Ginkgo, Taxodium, Sequoia, etc.), which point with stronger force to a probably temperate climate. The Pacific coast species was found with genera usually relied upon to prove a temperate climate, and while it was undoubtedly warmer than now, for the present forest vegetation is mainly or largely coniferous, there is little beside this to show that it was actually tropical.

NOTES ON MARS AND METEORS.

BY E. MILLER, LAWRENCE, KANSAS.

THE recent opposition of Mars, the appearance of Holmes's comet, and the meteoric display of the night of Nov. 23, 1892, were events that concentrated the attention not only of the general scientific world, but of specialists also, more largely than such events ever did before. It was thought that some of the celestial riddles were about to be solved, that some positive addition, neither nebulous nor fragmentary in its character, was to be made. Now, that they have all become things of the past, and it becomes possible to sum up the results of all the labor performed, theories propounded and exploded, and computations made, it is no wonder that the "*οἱ πολλοι*" ever impatient to see tangible results, and always clamorous in demanding large returns for even the smallest expenditures of time, labor, and money, are shouting "imposture." But science is not to be balked in this way; there is no release from this war.

The position of Mars relatively to the earth was such during the recent opposition that the best instruments and the best observers were at a great disadvantage. The results were not altogether satisfactory and in many cases were at variance with old theories and with each other. The observations made in this country, east of the Rocky Mountains, were scarcely of any value at all in the most of them, owing to the hazy condition of the atmosphere, as well as the low altitude of Mars. But west of the Rocky Mountains, especially along the Pacific coast, notably at Lick Observatory and the mountain observatory, near Arequipa, Peru, the conditions were the best attainable. At Guaymas, Mexico, on the coast of the Gulf of California, in latitude 27° 30′ N., the writer, about the middle of August, 1892, was impressed with the splendid appearance of Mars. The planet shone with a brilliancy that was almost, if not altogether, as great as it was at the opposition of 1877. Venus and Jupiter, also, seemed to have received extra touches of brilliancy that generally are not so pronounced in latitude 39° N.

Guaymas, located as it is on the shore of the Gulf of California, and surrounded by mountains ranging from a thousand to two thousand feet in height, with a sky that is always of the deepest blue, possesses advantages of a very superior kind, for an astronomical observatory. The great objection to such a location, to a northerner, would be the intense heat of the summer. In addition to the advantages for astronomical work, the harbor of Guaymas, as well as the Gulf itself, offers facilities and material for the study of marine life, that are beyond a doubt unsurpassed. A well-equipped biological station and some good biologists would soon furnish to the scientific world splendid results.

At midnight of August 18, 1892, as the writer was entering the open court of a large adobe house in Guaymas, in company with two or three friends, one of the most beautiful of celestial sights greeted their astonished vision. Suddenly from blue concave of the heavens, about midway between the zenith and the pole star, a meteor of the largest size shot out with a splendor of color such as is not often seen. The orange, red, violet, and other colors, were deep and most handsome to behold. Apparently, the meteor seemed to be moving from its initial point in a southerly direction, and had a disc, so to speak, almost equal to that of the full moon, and a train following that was remarkable for its width as well as its length. The train was broken into blocks of color that made this celestial visitant in all its outline, size, color, and general appearance, an intensely interesting object.

The stream of meteors, called the Andromedes, which our planet encountered on the 23d of November, made a very good display here in Kansas. Although no attempt was made to count the number or estimate the total fall of meteors during the night, except at intervals of five or ten minutes, yet judging from what was done in this discontinuous manner there must have been an average of from sixty to one hundred meteors per minute from 9 to 11 P.M. The "radiant point" was in Andromeda, from which by far the greater number seemed to start. Many others, apparently, had no connection with the "radiant," for they shot out from other points of the sky and at every moment. Generally, the meteors were small, but at times one more brilliant than the others appeared, adding very much to the interest of the observer. During the next four nights following the night of the 23d, it was hoped that a finer display would make its appearance, but two of the nights were overcast with clouds, and the other two, although clear, offered no show.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Breathing Wells.

REFERRING to the article of Mr. J. T. Willard in *Science* for Dec. 16, with reference to a "breathing well" in Kansas, I would say that such wells are also common in Nebraska. I have compared their behavior with the fluctuations of the barometer, and my observations agree with those of the writer in showing the entire dependence of the air movements in the well upon the changes in the atmospheric pressure outside. The cessation of an outward current from the well always corresponds with a curve of barometric depression, but always occurs some hours later than the minimum of pressure, and the amount of retardation depends upon the slowness with which the barometer rises.

These wells have often given considerable trouble in cold weather as the influx of cold air is liable to freeze the water in the pump at a considerable depth below the surface of the ground.

GOODWIN D. SWEZEY.

Crete, Neb., Dec. 23.

Hybridism in Genus Colaptes.

ACCORDING to the *résumé* of hybridism in the genus Colaptes by Professor Rhoads in *Science* for Dec. 9, it would appear that King's River was out of the limit of variation. Still I found one adult male of *C. cafer* at Dunlap, Cal., in the Sierra Nevadas, about 3,500 feet elevation, a perfect representative in every way save the occipital mark of *C. auratus*.

I also found an adult male in Cantua Creek, in the coast range, with the same marking. The former was in January, 1891, the latter in April, 1892. As both of these were found dead, I thought possibly the marking might have been caused by old age; but more probably they were stragglers from the north.

ALVAH A. EATON.

Riverdale, Cal., Dec. 26.

How Shall I Study Ants?

CAN some naturalist refer me to some article or book, or tell me himself how I can best keep a colony of ants, for inspection.

DWIGHT GODDARD.

Hosmer Hall, Hartford, Conn., Jan. 6.